



HISTORY OF MEDICINE



## The role of medical education in the development of the scientific practice of medicine

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### ABSTRACT

The authors describe the important role of medical schools and graduate medical education programs (residencies) in relationship to the advances in Medicine witnessed during the twentieth century; diagnosis, prognosis and treatment were revolutionized. This historical essay details the evolution of the education system and the successful struggle to introduce a uniform, science-based curriculum and bedside education. The result was successive generations of soundly educated physicians prepared with a broad knowledge in science, an understanding of laboratory methods and the ability to practice medicine at the bedside. These changes in medical education created a foundation for the advancement of medicine.

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During the last 150 years tremendous advances have taken place in the field of medical education. The product of these changes has been the development of physicians who have become progressively scientific in their mode of thought and practice over time. These physicians have been increasingly at the forefront of medicine, incorporating advances in every scientific field into the delivery of healthcare. A systematic and structured educational curriculum was created; this allowed the medical profession to train, through its educational institutions, physicians with the knowledge, skills and attitudes necessary for the scientific practice of medicine. Physicians were graduated with the capacity to study scientific advances, to interpret these advances relative to medicine and to incorporate pertinent elements into their medical practice. The practice of medicine today, contrasted with a century ago, has undergone a metamorphosis that could not have been predicted by the typical American medical graduate of 1900. Medicine has moved from a field based on dogma to one based on fact derived through scientific investigation and clinical observation.

Prior to the twentieth century there existed a plethora of theories explaining health and disease, each one of which conflicted with the other. After 1900 scientific medicine began to be practiced on the wards of several prestigious institutions, yet sectarianism and dogmatism continued to assert itself in the offices of the general practitioner for at least another 30 years, represented by such teachings as homeopathy, naturopathy, eclecticism and abramsism.[1] Each dogma proposed foundational principles of practice, closed to modification based on

observation. There were 22 US homeopathic medical colleges in 1900; Boston University School of Medicine, Hahnemann School of Medicine in Philadelphia (now Drexel), and the New York Homeopathic Medical College (now the New York Medical College) are three examples of schools that were founded on homeopathic principles, later to continue successfully as scientifically based institutions.[2]

By the dawn of the twentieth century scientific thought and scientific medicine had taken deep root in Germany. However, in the USA the average physician still practiced medicine based largely on the fallacious dogmatic *ipse dixit* of the particular theory of human health and disease to which the physician subscribed. Most medical school curricula did not include or support the scientific method or attempt to bolster their teachings with the results of experimentation. The unthinking acceptance of dogma was immortalized in William Cowper's poem, *The Task*.

*Books are oft times talismans and spells,<sup>1</sup>  
By which the magic art of shrewder wits  
Holds an unthinking multitude enthral'd.*[3]

As early as the middle of the nineteenth century, a group of progressive medical leaders began to emerge in the USA. They recognized the need for advancement and advocated for political initiatives. In 1846 the Medical Society of the State of New York called for a national medical organization to be formed, stating that it 'would be conducive to the elevation of the standard of medical education in the United States.'(p. 4). [4] This organization was founded as the American Medical Association

(AMA) in the following year. Its constitution stated the following as central to its purpose: 'cultivating and advancing medical knowledge' and 'elevating the standard of medical education.' (p. 2). [5] Change did not come quickly over the next 50 years, so that in 1902 Dr John Wyeth, president of the AMA, astutely appointed a Committee on Medical Education. The following year, that committee restated under the 'First Objective of the AMA' that the organization was 'formed for the purpose of elevating the standard of medical education.' [4] Sir William Osler, often referred to as the father of Internal Medicine, heralded the changes to come when he stated 'A new school of practitioners has arisen ... It seeks to study, rationally and scientifically ...' the practice of medicine. [6]

In the early years (1850–1900) medical schools in America, with a few exceptions, stood independent from universities and were proprietary in nature. These two factors tended to isolate the field of medicine from the other sciences. The most advanced medical schools were abroad and were part of established universities. German universities, with centers of learning in Vienna and Berlin, were held in high regard. American physicians frequently traveled to Germany, France and England to advance their post-graduate medical education. On returning home they emulated the practices of institutions they encountered abroad. [7] Henry P. Bowditch studied in Leipzig and was influenced by the physiological laboratory of Carl Ludwig. He subsequently developed the Institute for Experimental Medicine at Harvard, the first laboratory of its kind in the USA. Similarly, William Henry Welch studied with Ludwig and later went on to become the dean of the Johns Hopkins Medical School and one of the founding physicians of its hospital. He wrote 'I hope that the Johns Hopkins ... will be able to introduce German methods.' [8] In the early 1900s US physicians were handicapped because the leading medical journals were overwhelmingly in German and not available in the western hemisphere. Several quality US journals were founded in the 1800s and early 1900s to disseminate the findings of medical research. The American Journal of Medical Sciences, a well-respected journal in the USA and Europe, was established by Dr Isaac Hays in 1827. Hays is also credited with the preparation of the Code of Ethics of the AMA. The Journal of the American Medical Association was founded in 1883, [9] and in 1908 Heinrich Stern founded the Archives of Diagnosis, a leading medical journal of its time. [10] After attending a conference of the Royal College of Physicians in London in 1913, Stern returned intent on establishing a similar organization. He subsequently founded the American College of Physicians with the intent that it would foster the exchange of scientific information between physicians. [11]

Standards for admission to an American medical school were lax; a high school diploma was finally

mandated in 1905. [4] New York, through the Department of Education, was one of the few states to require a high school diploma as a prerequisite for medical school admission. Harvard did not require a baccalaureate as a prerequisite until 1901. [12] Medical schools by and large were two-year programs devoted to bookwork with little exposure to patients at the bedside. The student had little personal contact with the professor, and education was often restricted to lectures heard in an educational amphitheater. Patients were sometimes wheeled in to demonstrate some aspect of medicine to the student.

In 1910, the Carnegie Foundation released a bulletin on medical education in the USA, authored by Abraham Flexner. It became known as the Flexner Report and was regarded as an accurate description of the low standards in medical education at the time. Advocates for the advancement of medical education used it to encourage change. Flexner detailed, over 346 pages, the lack of a systematic and unified approach to medical education, the absence of suitable premedical education and minimal patient-based learning. He also described the factors responsible for the situation and made suggestions for corrective action. Interestingly, Flexner singled out the specialty of Internal Medicine for praise, describing it as the backbone of clinical teaching. He went on to cite another author, quoting '... Internal Medicine is regarded as the mother of all other clinical divisions.' [13]

Over the subsequent 30 years the educational landscape slowly began to succumb to the forces of change. Medical schools defined required premedical coursework, extended the duration of study to four years and incorporated a science-based curriculum. [12,14] They affiliated with universities and teaching hospitals, creating clinical clerkships during the last two years of medical school, allowing students patient-based experiences at the bedside. [15] Schools that could not accommodate these changes were closed.

Additionally, and importantly, after medical school physicians began to commit themselves to additional specialized educational training by attending hospital-based residencies. Widespread adoption of half-year or single-year internships came quickly, but longer programs of organized training were uncommon. The Johns Hopkins Hospital was established along the lines of the German medical clinics, incorporating full-time professors ('full-time system'), bedside teaching, clinical observation and laboratory science. [16] It also incorporated organized multi-year training. It opened its doors on 6 May 1889 and on 15 May admitted its first patient, a case of aortic aneurysm. This was the first patient to receive hospital-based care directly by graduate trainees who were part of an organized multi-year residency program. [17] Trainees were encouraged to evaluate the impact of treatment and effectiveness of diagnostic tests directly at the bedside. Such proof of

action is one aspect of the scientific method. No longer would treatment and diagnosis be based solely on theory. Thus, graduate medical education (GME) was born. Osler, Professor of Medicine at Johns Hopkins, felt that his role in the development of GME was his most important contribution to medicine.[18] Despite this early development of a modern residency program at Johns Hopkins, medical educators in the USA did not rapidly establish many other multi-year residencies. This is primarily thought to be due to their focused efforts initially to establish rigorous and reputable medical schools, and later the interruptions of World Wars I and II. In lieu of a residency in a medical specialty a physician could attend a condensed course at a so-called post-graduate medical college. These courses were often only weeks in duration. In 1914 there were 17 post-graduate medical schools in the USA, five each in New York and Illinois.[19] In 1934 the state of Pennsylvania still had only five residency programs of three years or more in length registered with the AMA's Council on Graduate Medical Education.[14] Multi-year residency programs preparing physicians for specialization were widely disseminated during the 10 years following the close of World War II.

The advances in medical education and the establishment of graduate medical education stand out as the most important developments in medicine in the last 150 years. They led to the graduation of successive generations of competent physicians, grounded in the scientific practice of medicine. Their openness to discoveries in all fields of science has allowed, with each passing year, for the expansion of medicine to ever-broader horizons.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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